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Surgical Treatment of the Patients with Cervical Disc Herniation at Clinical Center of University of Sarajevo, Bosnia and Herzegovina

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ABSTRACT

Background: Intervertebral disc herniations are caused by rupture of the fibrous ring and migration of one part of the nucleus pulposus towards the spinal canal. The most commonly affected levels are C5-C6 and C6-C7. Surgical treatment of cervicobrachialgia is indicated in the presence of long-term intense pain syndrome with or without radicular sensory-motor deficit and magnetic resonance (MRI) verified disc herniation with a compressive effect. **Objective:** The most common surgical treatment is anterior lateral microdiscectomy with or without the use of implants. In addition to this method, dorsolateral microsurgical treatment can be used for foraminal hernias. **Methods:** This retrospective study included 110 (58 / 52.7% male and 52 / 47.3% female) patients with cervical disc herniations who were surgically treated at the Neurosurgery clinic of Clinical Center of Sarajevo University (CCUS) in a five-year period. Stability, postoperative curvature, arthrodesis, implants, and changes in adjacent segments were radiographically analyzed. In the outcome assessment, functional outcome and patient satisfaction were analyzed using the Pain Self-Evaluation Scale (VAS), Prolo functional and economic score, and White's classification of treatment outcomes. **Results:** The dominant prevalence of changes was recorded at the levels of C5-C6 (58%) and C4-C5 (28%) with a ventrolateral approach performed in 90% of patients. The largest representation is hard dorsolateral discs (n = 77). In the group of patients with placed implant, hard discs were present in 96 (90%) cases (p < 0.001), while soft discs were dominant in patients without implant placement (p < 0.001). In the group of subjects with implant, the most common are hard dorsolateral discs and those of mixed localization in 41 of 55 patients (65.5%; p = 0.001). The most common implant is PEEK cage (74.5%). From complications, we had partial vertebral body fractures in 4.5% of patients. Furthermore, the most common are sensory disturbances in 2.73% of respondents. Reduction of symptoms and improvement of preoperative neurological status were observed in over 95% of patients. **Conclusion:** Surgical treatment of cervical disc herniation is a safe method with a minimal percentage of complications. Microsurgical discectomy significantly contributes to the improvement of the functional status of patients, the reduction of pain, and the improvement of neurological deficit and overall mobility.

Keywords: Cervical disc herniation, surgical treatment, microsurgical treatment, implant, VAS, Prolo functional status.

1. BACKGROUND

Cervicobrachial neuralgia is defined as neck pain associated with radicular pain in the upper extremity. Intervertebral disc herniations are caused by the rupture of a fibrous ring and the migration of one part of the nucleus pulposus towards the spinal canal. They can be soft or hard in consistency (1). The most common symptomatology is pain, motor and sensory deficit. The pain is limited to the corresponding root with associated pain between the shoulders (2). Degenerative lesions begin relatively early, at the age of 20. The lesions involve successively the disc ("soft" disc herniation, calcified disc herniation or "hard" disc herniation), uncovertebral joints, ligament apparatus. Lesions can sometimes be limited to one or more levels, most commonly at the C5 / C6 and C6 / C7 levels. Degenerative lesions can also be the cause of loss of physiological lordosis, kyphosis, chronic instability, then degenerative spondylolisthesis with modification of the orientation of the joint surfaces. Due to the movement of flexion and extension, the ligaments can lose their

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elasticity and can bulge into the interior of the spinal canal and participate in medullary injuries (3, 4).

2. OBJECTIVE

The most common surgical treatment is anterior lateral microdiscectomy with or without the use of implants. In addition to this method, dorsolateral microsurgical treatment can be used for foraminal hernias (5, 6).

3. PATIENTS AND METHODS

We present surgical treatment results in patients with cervical disc herniation at one or more levels using a standard microsurgical approach or implant placement during surgical treatment. The sample included 110 patients operated at Neurosurgery Clinic of Clinical Center of University in Sarajevo (CCUS) over a five-year period. Patients were stratified into four groups. In the first and second groups, standard microsurgical approaches, anterior lateral discectomy, and dorsal microsurgical approach were used. In the third group, anterior lateral discectomy with implant placement (PEEK) was performed. In the fourth group, a combined surgical approach was used, which includes anterior microdiscectomy with an implant and laminectomy. All patients underwent cervical spine radiography (X-ray) and magnetic resonance imaging (MRI), and in a small number of patients, where the radiological picture was not clear, computed tomography (CT) was used. Stability, curvature, disc height, and osteophytes were analyzed on functional X-rays, and disc size, location, number of affected levels, and medullary compromise were analyzed by MRI. If the patient had multi-level hard disc, EMNG was also used. In terms of outcomes, the occurrence of intraoperative and postoperative complications was observed. Postoperative consequences in the form of neck pain were assessed. The control clinical assessment and radiography of the cervical spine were performed on the first postoperative day, then two months and one year after the operation. Radiography analyzed stability, postoperative curvature, arthrodesis, implants, and changes in adjacent segments. In order to assess treatment outcomes, functional outcome and patient satisfaction were analyzed. The functional outcome of surgery was assessed using the Pain Self-Evaluation Scale (Visual analog Scale-VAS), Prolo functional and economic score (7), and White's classification of treatment outcomes (8).

Statistical analysis

Descriptive and analytical statistical methods were used in data analysis; SD, Student's T test, Fisher's exact probability test Pearson (χ^2) Chi square test, Mann Whitney test, Spearman's rank correlation test. Data processing was performed using the SPSS package, version 20 (SPSS Inc., Chicago, IL, USA).

4. RESULTS

Out of the 110 patients, 58 (52.7%) were male and 52 (47.3%) were female. There were no statistically significant differences by sex between those operated with and without insertion ($\chi^2 = 6.563$; $p = 0.0872$). There was also no statistically significant difference in age between operative approaches according to the analysis of variance (ANOVA-F = 0.254; $p = 0.725$). Motor as well as sensitive deficit was present almost equally in all groups ($\chi^2 = 0.380$; $p = 0.538$). The highest prevalence of changes in the discus was at the levels of C5-C6 (58%) and C4-C5 (28%). Ventrolateral approach was dominant (in almost 90% of patients). Hard dorsolateral discs were most prevalent (77 operated levels in 55 patients).

The analysis of the type of dominant neurological presentation indicates a greater presence of radicular presentation in surgical procedures without implants, and a greater presence of medullary presentation in the use of implants ($p = 0.001$) (Table 1). More frequent cervical spine disorders on preoperative X-ray were present in the group of patients operated with an implant than in the group operated without an implant ($\chi^2 = 8.279$; $p = 0.004$) (Table 2).

In the group of subjects operated with implant placement, the prevalence of patients with two or more affected levels is higher than in the group operated without implants ($\chi^2 = 18.274$; $p < 0.001$) (Table 3).

		Neurological presentation			Total	
		Radicular	Medular	Combined		
Operative approach	Microdiscectomy	N	32	6	11	49
		%	65.3	12.2	22.4	44.5
	Dorsolateral approach	N	6	0	0	6
		%	100.0	.0	.0	5.5
	Microdiscectomy with implant	N	36	4	9	49
		%	73.5	8.2	18.4	44.5
	Combined approach	N	0	4	2	6
		%	0.0	66.7	33.3	5.5
Total	N	68	10	20	110	
	%	69.4	10.2	20.4	100.0	

Table 1. Neurological presentation in correlation with operative approach

		Preoperative cervical X rays			Total	
		Curvature disorder	Reduced disc space height	Representation of osteophytes		
Operative approach	Microdiscectomy	N	22	31	36	49
		%	44.9	63.3	73.5	44.5
	Dorsolateral approach	N	2	0	0	6
		%	33.3	.0	.0	5.5
	Microdiscectomy with implant	N	36	34	39	49
		%	73.5	69.4	79.6	44.5
	Combined approach	N	6	6	6	6
		%	100.0	100.0	100.0	5.5
Total	N	66	71	81	110	
	%	60.0	64.5	73.6	100.0	

Table 2. Preoperative X-ray of the cervical spine with analysis of disorders of the curvature of the cervical spine, disc height and the presence of osteophytes according to operative approaches

			Levels			Total
			1	2	3 and more	
Operative approach	Microdiscectomy	N	38	11	0	49
		%	77.6	22.4	.0	44.5
	Dorsolateral approach	N	6	0	0	6
		%	100.0	.0	.0	5.5
	Microdiscectomy with implant	N	17	30	2	49
		%	34.7	61.2	4.1	44.5
	Combined approach	N	0	3	3	6
		%	.0	50.0	50.0	5.5
Total		N	61	44	5	110
		%	55.5	40.0	4.5	100.0

Table 3. MRI verified cervical levels involved in the process

			Disc Consistency		Total
			Soft disc	Hard disc	
Operative approach	Microdiscectomy	N	16	33	49
		%	32.7	67.3	44.5
	Dorsolateral approach	N	6	0	6
		%	100.0	.0	5.5
	Microdiscectomy with implant	N	12	37	49
		%	24.5	75.5	44.5
	Combined approach	N	0	6	6
		%	.0	100.0	5.5
Total		N	34	76	110
		%	30.9	69.1	100.0

Table 4. Intraoperative consistency of the discs.

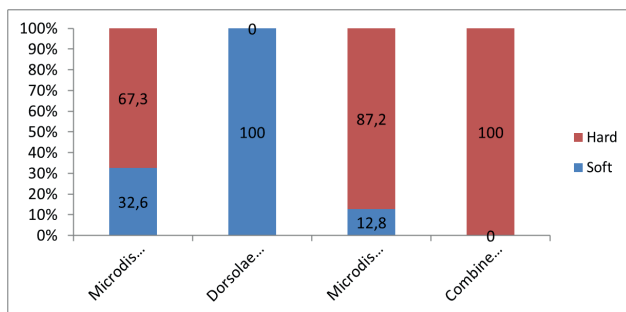


Figure 1. Consistency of disc according to operative approaches at 155 operated i.v. levels.

Hard discs were predominantly present in the group of patients with implantation in 96 (90%) cases (Figure 1) ($p < 0.001$), and soft discs were dominant in the group of patients in which i.v. insert ($P < 0.001$) (Table 4).

In the group of subjects with an implant, the most common were dorsolateral hard discs and mixed localization hard discs in 41 of 55 patients (65.5%) ($p = 0.001$). All patients who did not have the implant were operated on at one level. The most commonly implant was a PEEK cage (74.5%). Bone and prosthesis were implanted only in one-level operations, and palacos in two- and three-level operations. Cage has been implanted in both one- and three- and three-level operations, but more often in two- and three-level operations. Immediate postoperative complications of various forms were present in 10 patients (9.1%). After surgery, patients with soft discs of dorsomedial localization had higher mean values

on the VAS scale (16.0) than patients with dorsolateral localization (10.0).

In patients with hard disc after surgery, there was no statistically significant difference in the values of VAS score in relation to the localization of the disc ($F = 0.529$; $p = 0.92$). The average values of VAS score decreased compared to the values before surgery in all three disc localizations as follows: in patients with dorsomedial localization from 37.75 before surgery to 21.25 after surgery ($t = 10.614$; $p = 0.002$), in patients with dorsolateral disc localization from 51.3 before to 19.0 postoperatively ($t = 70.760$; $p < 0.001$) and in patients with mixed disc localization from 48.86 before to 19.1 postoperatively ($t = 70.575$; $p < 0.001$).

In terms of the average patients age, the oldest were those who had a combined operative approach with an average age of 62.09 +/- 9.24, and the youngest patients underwent microdiscectomy with an insert with an average age of 44.12 +/- 4.38 years. Patients with a mean age of 48.05 +/- 5.24 years were treated with microdiscectomy and patients with a mean age of 52.35 +/- 8.53 years were treated with the dorsolateral approach. It can be observed that patients with multi-level disc changes operated with the combined approach were the oldest at 62 ± 9.2 years.

Regarding the presence of motor and sensitive deficit in relation to the operative approach, we obtained the following results: about 2/3 of the respondents had a sensitive deficit, and slightly more than 1/3 had a motor deficit, with patients with a combined approach having both deficits. A pronounced motor deficit was present in microdissectomized patients, in whom sensory deficit was present at the same time in 2/3 of the subjects. Motor as well as sensitive deficit was present almost equally in all groups ($\chi^2 = 0.380$; $p = 0.538$).

5. DISCUSSION

We found almost the same proportion of men (52.7%) and women (47.3%), with no statistically significant gender differences between the group of patients operated with and without implant placement ($\chi^2 = 6.563$; $p = 0.0872$). 53.1% of women were treated with microdiscectomy, while men were in the lead in other surgical approaches. In a study by Alifdal et al., Men were dominant in surgically treated patients (12).

According to the age, the oldest were patients who had a combined operative approach with an average age of 62.09 +/- 9.24, and the youngest patients underwent microdiscectomy with an insert with an average age of 44.12 +/- 4.38 years. In comparison with the results of other studies, it is recorded that our patients who were operated on are, on average, older. Thus, in the Nohr study, the average age is 43-46 years, depending on the type of surgery with and without implantation of a griffin (13).

In another study, the average age was between 40 and 50 years (12).

Motor and sensitive deficit was present almost equally in all groups ($\chi^2 = 0.380$; $p = 0.538$). One study showed motor deficit in 83 % of implant-free microdissectomies and with implant in 64% of patients. Sensory deficit in microdissectomies without implant in 58% of cases, and with implant in 61% of subjects (13). These results are in agreement with our results. About 70% of our subjects had a dominant radicular presentation of pain. All patients operated with the dorsolateral approach had radicular symptomatology, followed by patients who had microdissectomy with an insert. 66.7% of patients with medullary lesion had a combined surgical approach. Analysis of the type of dominant neurological presentation in our sample indicates a greater presence of radicular presentation in microdissectomies without an insert, and a greater presence of medullary presentation when using an insert, with statistically significant differences ($p = 0.001$). In a study by Hallacq et al., Conducted on 70 patients who underwent soft dorsolateral hernias, all had radicular symptomatology and all underwent a dorsolateral approach (14). A study conducted on 450 patients undergoing surgical treatment of a herniated disc in the cervical segment, by Raja et al. Showed 61% of patients with radicular symptomatology, and 16% of pure myelopathic symptoms (65).

Preoperative X-rays of the cervical spine were performed on all operated patients, where the analysis of cervical spine curvature disorders, disc height and the presence of osteophytes was performed. Osteophytes were present in 73.5% of patients undergoing microdissectomy without an insert, and almost 80% with an insert. All patients treated with the combined approach had osteophytes, and none underwent surgery with the dorsal microsurgical approach. Curvature disorder was present in 1/3 of the subjects treated with microdissectomy and in all treated with the combined technique. All patients treated with the combined technique had reduced disc height and none with the dorsolateral approach, and two thirds of the subjects treated with microdissectomy. Similar results are reported by other authors (4, 6, 9, 13, 15). More frequent disorders of the cervical spine on preoperative X-ray were present in the group of patients operated with an insert than in the group operated without an insert. The chi-square test yielded a highly statistically significant difference ($\chi^2 = 8.279$; $p = 0.004$). Topographic localization of disc herniation according to MRI in relation to the posterior edge of the vertebra compared with the operative approach showed that in our sample all patients with dorsolateral soft disc herniation had a dorsolateral microsurgical approach and a combined approach with mixed localization, and that dorsolateral localization was dominant. was present in both microdissectomy with and without insertion. The chi square test did not show a statistically significant difference in the topographic localization of the disc herniation according to MRI between the group operated with and without the insert ($p > 0.001$). The same observations are made by other authors (13, 15, 16-17).

In the analysis of the frequency of disc levels, the most common localization is at the levels of C5-C6 (58%) and C6-C7 (41%), which is comparable to the results of Bruno et al. (3). In the examined sample, we analyzed the consistency and localization of the discs found during the operation, independent of the surgical approach. Thus, we obtained that hard dorsolateral discs were present in 49.7% of the operated and 45.5% of patients, and soft dorsolateral in 15.5% of the operated and 21.8% of patients, respectively. The chi-square test yielded a highly statistically significant difference in disc consistency between the group operated without and the group operated with the insert ($p < 0.001$). In the analyzed sample, the most frequently implanted implant is PEEK (74.5%), while bone and prosthesis were implanted only in one-level operations, and palacos in two- and three-level operations. Cage has been implanted in both one- and three- and three-level operations, but more often in two- and three-level operations. The Kruskal-Wallis test yielded a highly statistically significant difference in the number of levels relative to the type of implant implanted in the anterolateral approach ($H = 25.745$; $p < 0.001$). This disproportion in the type of inserts is in the current disposition of the material during surgical procedures. In contrast to our results, Eva most commonly used a tricortical iliac griffin in 33.36% of subjects, a PEEK cage in 5.45% of cases in an anterior operative approach, while the remaining patients were treated with a posterior operative approach or simple microdissectomy (18).

In our sample 79% of our patients with an anterior lateral approach had an implanted cage, 12% "palacos" while almost the same number had an implanted bone or prosthesis. One study analyzed the work of neurosurgeons from the Francophone area. It was found that over 35% do not use implant, 26% use implant without osteosynthesis, 17% use implant with a holder, to improve mechanical stability osteosynthesis. Other techniques were also used, but in a much smaller percentage (3). In our sample of intraoperative complications, we encountered only a partial fracture of the vertebral body from ecarter in 4.5% of subjects, which is comparable to the available results of world studies, and which depends primarily on the degree of osteoporosis preoperatively (3,17, 19-20).

In order to evaluate the success of the operations, we monitored the postoperative consequences in the form of neck pain and stiffness two months after surgery and physical treatment, and we found that all patients who underwent the combined approach had axial neck pain, of which 83.3% had postoperative stiffness, while in terms of pain postoperatively the best results were obtained by microdissectomy ($\frac{1}{4}$ subjects), and postoperative stiffness in this group was the least present, in only 12.2%. In 1/3 of the subjects operated with the dorsolateral approach and microdissectomy with the insert, they had axial pain with equal postoperative stiffness. The chi-square test did not show a statistically significant difference in postoperative consequences between operative approaches ($\chi^2 = 0.566$; $p = 0.904$).

Research by Yonenobu et al found that postoperative pain was more pronounced in the posterior approach, facet arthrosis, preparative stiffness, and old age had implications in the pathogenesis of axial pain. Many patients have their symptoms stopped after a year. They noted that the prevalence of postoperative pain was highest after laminoplasty (60%) of 203 examined patients, and after laminectomy 27% of 115 patients and after anterior access 19% of 209 patients (21). Our results showed results similar to Yonenobu, given that in all groups there was a reduction in neck pain and stiffness one year after surgery and physical treatment, but patients operated with a combined approach still had pain in 66.7% of cases. The chi-square test did not show a statistically significant difference in postoperative consequences between operative approaches one year after physical treatment ($\chi^2 = 2.319$; $p = 0.508$).

Upon discharge after surgical treatment, dysphagia was noted as a complication in almost 30% of subjects, most of whom were most often present in the population of patients operated with a combined approach, followed by microdisectomy with an insert. Although a higher presence of dysphagia was observed in the group of patients operated with the insert, due to the lack of possibility of comparison with other consequences, it was not possible to perform a statistical analysis of the significance of this difference. In a study conducted by Bazaz et al., It was stated that the prevalence of dysphagia was present in 50% (99 of 197 patients) and that it dropped to 12.5% (19 of 152 subjects) after one year (22). Dysphagia is more common, when surgical procedures are performed on several levels and when installing plates and screws (6). Of the immediate postoperative neurological complications, we most often encountered sensitive symptoms in exacerbation in 2.73% of subjects, and then in 1.82% we found C5 radiculopathy and Horner's syndrome, and a recurrence lesion. Less than 1% of patients had immediate motor impairment. Fountas et al reported Horner's syndrome in 0.1% of a total of 1,015 patients operated on (23). Bertalanffy and Eggert had Horner's syndrome in 5 of a total of 450 patients (1.1%), and all underwent anterior approach surgery, which is comparable to our results (24).

Comparing the mean values of VAS score before and after surgery in the group of patients with soft dorsomedial discs, we found that there was a decrease from 32.0 to 16.0. The student's t-test yielded a highly statistically significant difference ($t = 16,000$; $p < 0.001$). Also, there was a decrease in the mean value of VAS score in the group of patients with soft discs of dorsolateral localization from 80.21 before surgery to 10.00 after surgery. The student's t-test yielded a highly statistically significant difference ($t = 57,465$; $p < 0.001$). In patients with hard discs after surgery, the mean values of VAS score decreased in relation to the values before surgery in all three disc localizations: in patients with dorsomedial localization from 37.75 before surgery to 21.25 after surgery ($t = 10.614$; $p = 0.002$), in patients with dorsolateral disc localization from 51.3 before to 19.0 after surgery ($t = 70.760$; $p < 0.001$) and in patients with mixed disc

localization from 48.86 before to 19.1 after surgery ($t = 7057.5$; $p < 0.001$).

A good result based on Prolo almost two months after surgery was in 70 (94.6%) patients with purely radicular symptomatology, and in 68 (91.9%) patients one year after surgery. Two patients in each group had a poor result two months after surgery and three patients a year after surgery. In a study by Nohra et al., 101 patients were evaluated after 54 months in the cage implant group and after 45 months in the microdisectomy group. Good results were achieved in 95.6% in the group with cages and 97.3% in the group with microdisectomy (13). By White classification in pure radicular symptomatology two months after surgery, a good result was achieved in 94% of microdisectomies without and 95% with insertion, and after one year in 92% in both groups, which is comparable to the results of Nohr et al. had 94.5% good results in the group with inserts and 94.9% without inserts (13).

In our study, no significant difference in the outcome of surgical treatment with or without insertion was recorded. It has been proven that the outcome of operative treatment depends on the localization and consistency of the disc, as well as the extent of preoperative neurological deficit. Surgical treatment of cervical disc herniation significantly improves the functional status of the patient.

6. CONCLUSION

Most cervicobrachialgias caused by cervical disc herniation are treated by standard conservative procedure. Surgical treatment of cervicobrachialgia in cervical disc herniation is indicated in the presence of long-term intense pain syndrome with or without radicular sensory motor deficit refractory to standard conservative therapy, and NMR shows disc herniation with a compressive effect. The obtained results showed a reduction in discomfort and improvement of preoperative neurological status in over 95% of patients with predominantly radicular symptoms. The conducted research proved that the functional status and satisfaction of patients after microsurgical surgical treatment of cervical disc herniations were significantly improved, both in terms of reducing pain, and in terms of improving neurological deficit and overall mobility.

- **Patient consent form:** All participants were informed about subject of the study.
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